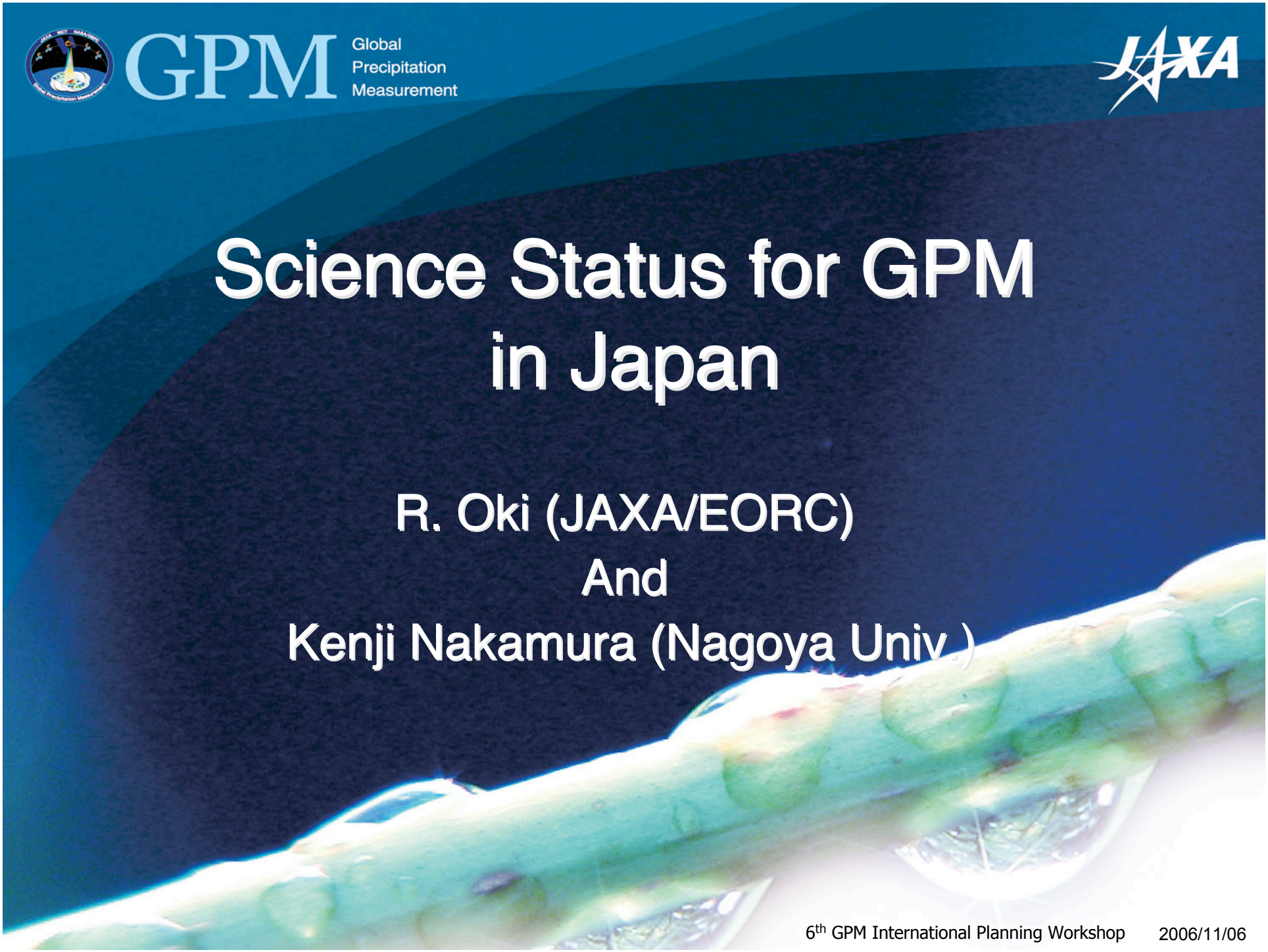


Science Status for GPM in Japan

R. Oki (JAXA/EORC)
And
Kenji Nakamura (Nagoya Univ.)

Main objective of GPM

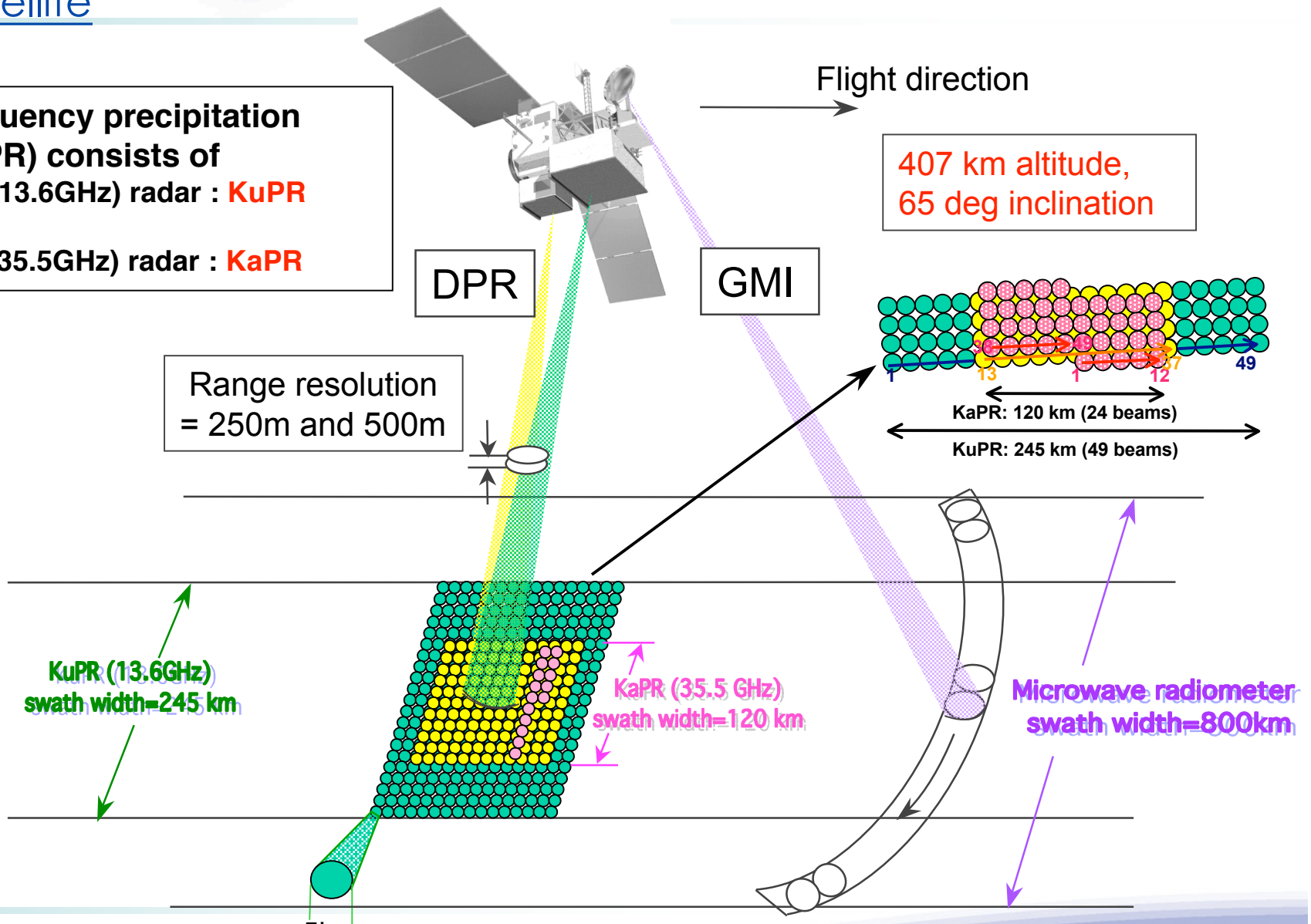
- **To establish accurate and frequent global precipitation observation system**

Basic Mission Requirements of GPM

(1) To observe the global precipitation
(2) To accurately measure the precipitation
(3) To frequently measure the precipitation

Concept of precipitation measurement by the GPM core satellite

Dual-frequency precipitation radar (DPR) consists of
-Ku-band (13.6GHz) radar : KuPR
and
-Ka-band (35.5GHz) radar : KaPR



GPM science team

- K. Nakamura (Nagoya Univ., EORC/JAXA): chair
- T. Iguchi (NiCT): sub-chair
- R. Oki (JAXA): project

- Algorithm group: chaired by T. Iguchi (JAXA)
- Cal/Val: by S. Shimizu (JAXA)
- Data: by T. Takeshima (JAXA)
- Engineering: by K. Furukawa (JAXA)
- Science and applications: all

- The first meeting: 26 August 2003
- The second meeting: 13 February 2004
- The third meeting: 18 March 2005
- The fourth meeting: 23 March 2006
- The fifth meeting: March 2007

GPM science team (31 members + JAXA)

- K. Aonashi (MRI): microwave retrieval
- Y. Asuma (Hokkaido Univ.): cold region weather system and snow
- J. Awaka (Hokkaido Tokai Univ.): DPR algorithm
- K. Fukami (PWRI/ICHARM): hydrology, flood warning
- Y. Fujiyoshi (Hokkaido Univ.): snow storms
- T. Iguchi (NiCT): DPR algorithm
- T. Inoue (JMA): cloud observation
- K. Itoh (IDI/IFNet): flood warning
- K. Iwanani (NIESDP): radar observation
- Z. Kawasaki (Osaka Univ.): lightning
- A. Kitoh (MRI): climate modeling
- M. Kubota (Tokai Univ.): oceanography
- T. Koike (Univ. Tokyo): hydrology, water problem, GEO
- T. Kozu (Shimane Univ.): DPR design, DPR algorithm
- M. Murakami (MRI): cloud physics

GPM science team (cont'ed)

- A. Nakakita (Kyoto Univ.): radar rain and water resources
- T. Nakazawa (MRI): tropical meteorology and typhoon
- H. Ohno (Agriculture): Application to agriculture
- K. Okamoto (Osaka Pref. Univ.): radar algorithm
- T. Oki (Univ. Tokyo): hydrology, global water resources
- T. Ose (JMA): model evaluation
- T. Sato (Kyoto Univ.): radar engineering
- M. Satoh (Univ. Tokyo): climate modeling, Earth Simulator
- S. Shige (Osaka Pref. Univ.): latent heat profile retrieval
- A. Sumi (Univ. Tokyo): climate modeling
- N. Takahashi (NiCT): radar rain retrieval
- Y. Takayabu (Univ Tokyo): tropical meteorology
- Y. Takeuchi (JMA): weather modeling
- T. Tanaka (Yamaguchi Univ.): ground validation
- H. Uyeda (Nagoya Univ.): Baiu/Meiyu and meso-precipitation system
- T. Ushio (Osaka Pref. Univ.): DPR observation, lightning

GPM science team (cont'ed)

- More involvement of "operational people": partly done
- More involvement of "snow people": partly done

- Objectives
  - Make current progress of GPM/DPR be known.
  - Explore new sciences and/or applications.
  - Evaluate the activities.
  - Respond to various activities such as GDWaG and GV.

- Discussion topics
  - Overall strategy of Japan's activity
  - Science and applications
  - DPR specification
  - DPR algorithm development
  - GV methods

Japan's strategy

- Japan's contribution to GPM is via DPR observation.
  - The core satellite is the hub of GPM. The core is essential.
    - TRMM: PR and TMI comparison improved the accuracy.
    - WCRP Satellite WG emphasizes cross-calibration, overlapping.
  - Japan will contribute for the full utilization of DPR.

- Japan's GV will put emphasis on the DPR validation/evaluation.
  - Take advantage of TRMM GV experiences
  - Space oriented verification
    - Radiometrically consistent way
- Examination of appropriateness of the assumed precipitation system model
  - DPR, GMI (+AMSU type sounder?)
  - Full utilization of quasi-simultaneous observations
  - Specific challenges: for example, direct-mirror echo, SRT (Ku, Ka, delta), etc.,

Higher Accuracy is required for climate research rather than for flood prediction and river control.

- How the precipitation pattern and amount changes with El Nino/La Nina quantitatively
- Detection of global precipitation change associated with global warming
- Error covariance → data assimilation →forecast score

- Less than 10 % error is required to detect climate change.
- Accuracy of snow rate retrieval by DPR/GPM is crucial.

TRMM's results

- More accurate precipitation distribution
- Direct comparison with climate model results
- Opened the era of "global precipitation system climatology".
- Opened the era of "space radar precipitation observation".

Science and application activities

Algorithm development

- DPR algorithms development
  - Simulation data generation for algorithm development (simulated DPR obs. mode with PR)
  - Investigation of DPR level 1 and level 2 algorithm (KuPR, KaPR, and dual frequency algorithm) continues by 3 RIs (Research Invitation)
- DPR/GMI combined algorithm study
  - continues by a working group under the science team
- Study on use of Sounder data
  - Preliminary survey of utilization of microwave sounder data for GPM has been started
- Global rain map algorithm
  - CREST GSMaP led by Prof. K. Okamoto → Dr. Takahashi will introduce the details

Ground Validation

- Synthetic data set at super-site (Okinawa) (trial)

High resolution non-hydrostatic atmospheric model

- Earth Simulator

Applications

- Operational weather forecast
- Flood warning
  - Joint study with Public Works Research Institute has been started regarding GPM application for flood monitoring (→ Mr. Inomata)

GPM Science document (in Japanese) was prepared after the 4th meeting and will be published soon

Flood warning application

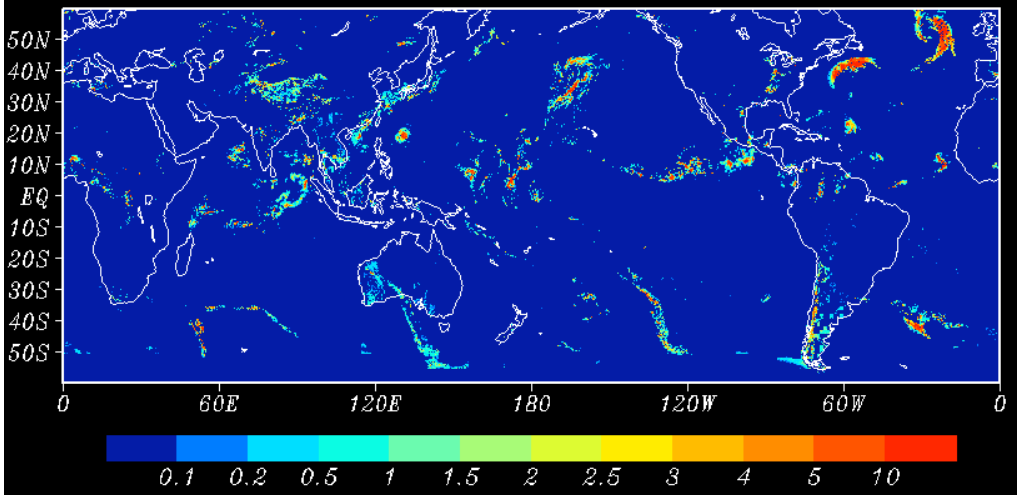
- IFNet's Global Flood Alert System (GFAS), proposed by MILT and JAXA at 3rd World Water Forum (2003), is running in trial basis to provide estimated precipitation probability, and heavy rainfall information to registered organizations/users.
- JAXA and ICHARM/PWRI also started joint research to utilize satellite rainfall information in future flood early warning system, which should be successor of GFAS.

Proto-type of real-time system

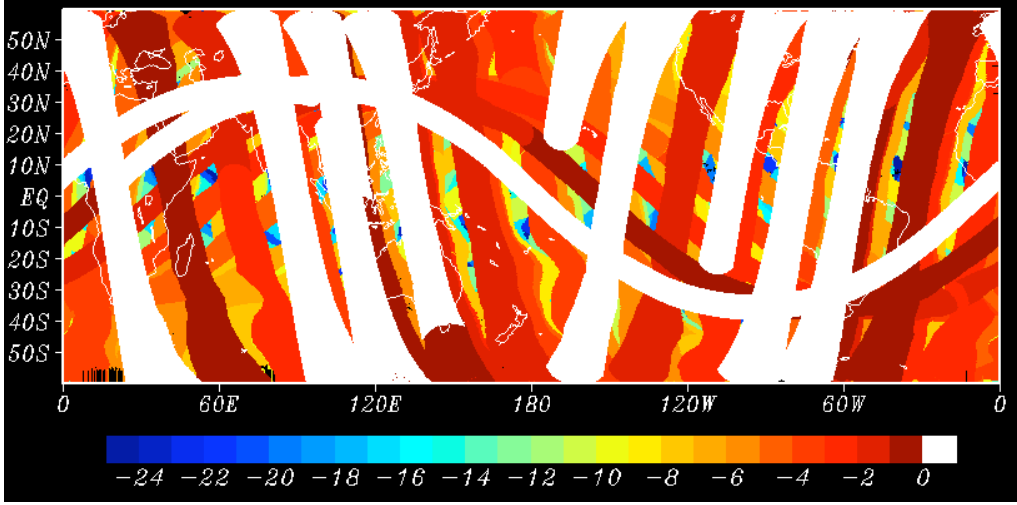
- Proto-type of real-time system for producing high-frequent and high-accurate global rainfall map is developed and tested at JAXA/EORC, in collaboration with GSMaP team, led by Prof. Okamoto.
  - Core algorithms of the system are based on those provided by GSMaP project, using TRMM, AMSR-E, SSM/I and geostationary satellite information as inputs.
- Incorporating not only for providing rainfall information, but also for incorporating feedback from end-users, in the process of development of the system.
- Those collaborations will be precursor for GPM era and will realize the idea of GEOSS.

Example of GSMaP real-time version

GSMaP_MV (Precipitation) [mm/hr]

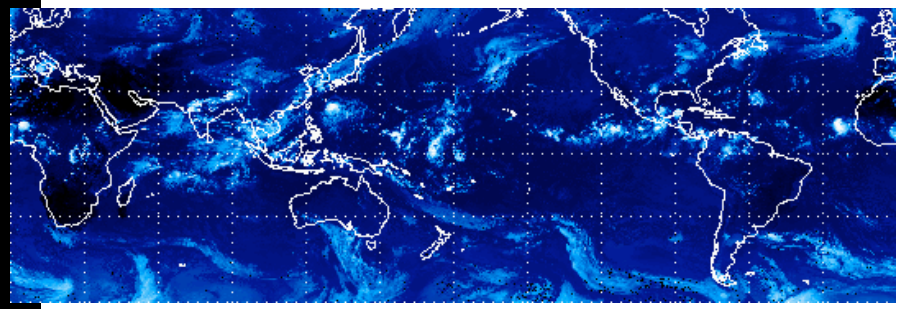


Diff. of MWR obs. hrs. from/to present.



12Z 12 Sep. 2006

IR images



Observation time (hrs) of Microwave Radiometers at each pixel is denoted by hours from/to present hour.

4th GPM science team meeting (23 March 2006)

- **Review and discussion about mission success criteria, mission requirements, DPR specification**
  - Success criteria (Minimum, Full, and Extra)
    - Defined by ground rain amount, specific goals (daily, 10,000 km^2 level?)
    - Need observation that enables us to understand structure of precipitation systems in order to improve the rain estimates over land.
  - The minimum guaranteed observation height: 18km → 19km (accepted)
- **Overview of the research and application activities in Japan**
  - Science document (in Japanese)
  - DPR/GMI combined algorithms (especially for solid particles)
  - Steady improvement of JMA prediction model and data assimilation system. (→ Mr. Sato of JMA)
  - Progress in large scale non-hydrostatic model will realize direct comparisons between model-based and satellite-based precipitation system climatologies.
  - Improvement of flood forecasting, early warning, particularly, poorly gauged or ungauged basins

4th GPM science team meeting (23 March 2006)

- **Need to keep the momentum in spite of the delay of GPM**
  - Need some pre-GPM products which could be useful even before GPM establishment.
    - GSMaP product
    - Deepening TRMM utilization products
      - "precipitation system climatology"
      - Developing of models of microphysics dedicated for microwave remote sensing.
    - Flood prediction/warning
    - GV, algorithm validation
    - Extension of TRMM results to, for example, CloudSat data.
    - Others
- **New science team**
  - May need to combine GPM team with TRMM team
  - Precipitation Mission RA (actually TRMM RA) will start in JFY2007 (3 years)
  - New GPM RI will also start in JFY2007
    - DPR algorithm PIs only → broader study areas, DPR, global map, physical GV, applications using existing data to survive prolonged years before GPM